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PLAN OF STUDY
CONODOGUINET CREEK
AND
YELLOW BREECHES
WATERSHEDS
A WATER RESOURCE
ASSESSMENT

SUSQUEHANNA RIVER BASIN COMMISSION

VOID
03-59-638-4

JULY 1989

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The Susquehanna River Basin Commission was created as an independent agency by a Federal-Interstate Compact* among the States of Maryland, New York, Commonwealth of Pennsylvania and the Federal Government. In creating the Commission, the Congress and State Legislatures formally recognized the water resources of the Susquehanna River basin as a regional asset vested with local, State and National interests for which all the parties share responsibility. As the single Federal-Interstate water resources agency with basinwide authority, the Commission's goal is to effect coordinated planning, conservation, management, utilization, development and control of basin water resources among the government and private sectors.

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Lazorchick, George J.
Plan of study

SUSQUEHANNA RIVER BASIN COMMISSION

Robert J. Bielo
Executive Director

PLAN OF STUDY

CONODOGUINET CREEK AND YELLOW BREECHES CREEK WATERSHEDS

A WATER RESOURCE ASSESSMENT

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INTRODUCTION

I. Purpose of the Study

The Conodoguinet Creek and Yellow Breeches Creek Watersheds are located in an area of south-central Pennsylvania that is currently experiencing a high rate of residential and commercial growth. This growth has increased the demand on the water resources of the region. Consequently there is concern in the public and private sectors as to whether enough water is available to meet all demands without seriously degrading the quality of the water supplies. This regional study of the Conodoguinet Creek and Yellow Breeches Creek Watersheds is designed to evaluate the availability of water in both watersheds. Water availability will then be compared with the levels of demands that are currently being experienced as well as against the levels of demand expected through the year 2010. The principal product of this study will be the development of a water resource management strategy for the watersheds derived from the evaluation of the interactions of water quantity, water quality, instream and out-of-stream demands; and the economic, environmental, engineering and political feasibility of various management alternatives. This study will also consider public opinion, political considerations and constraints, and agency criteria as well as individual, industrial, commercial, and public water supply management ideas in the formulation of the final water resource management strategy.

The water resource management strategy will be used by the SRBC in the review of projects affecting both water quantity and water quality in the watersheds. Projects in either of the watersheds subject to Commission review or regulation will be evaluated in accordance with the management strategy. Provisions will be included for reviewing or updating the strategy as the need arises. The findings will also be made available to the general public and decision makers at all governmental levels for use in the difficult land use and planning decisions that they face.

In addition, the procedures developed during this study will guide the Commission in evaluating the water resource needs, uses and problems in other areas of the Susquehanna Basin. These procedures and strategies will help the Commission fulfill its mandated mission which, as defined in the Compact which created the Commission, is to bring about the coordinated planning and management of the water resources of the basin.

II. Background Information

A. Description of Study Area

The study area includes the contiguous watersheds of the Conodoguinet Creek and the Yellow Breeches Creek. The Conodoguinet Creek drains an area of 506 square miles and extends from its mouth at the Susquehanna River upstream a distance of approximately 100 miles. The Yellow Breeches Creek extends from its mouth at the Susquehanna River upstream a distance of 49 miles and drains an area of 219 square miles immediately south of the Conodoguinet watershed. The locations of these watersheds are shown on Figures 1 and 2.

1. Topography and Geology

Steep, forested ridges of resistant rock formations in Blue Mountain and South Mountain (Figure 2) bound the Conodoguinet and Yellow Breeches watersheds on the north - northwest and southeast, respectively. A broad valley of low to moderate relief between these ridges is generally underlain by shale north of the Conodoguinet Creek and by limestone in the remainder of the valley. Sinkholes form prominent surface features in the valley. In addition, a diabase dike forms a subdued ridge on the valley floor. The valley area has an overall relief of approximately 400 feet with the maximum relief between ridge crest and valley bottom being approximately 750 feet. South Mountain is dissected into numerous ridges by mountain streams. Relief along these streams is locally steep; however, it is generally moderate and averages 250 to 300 feet. The watershed divide to the southwest crosses the valley in an area of very low relief.

2. Population

The population of the study area has increased substantially since the end of World War II. Most of the boroughs reached their peak population in 1970 or earlier, while the majority of the townships continue to grow to the present day. This difference is likely explained by the differential amount of open space available for residential development. The boroughs--small, older population centers--had much of their developable areas filled by the postwar suburbanization. Townships continue to grow as large tracts of land, formerly used for agriculture, are converted to residential and commercial areas.

Population data for the study area and the state are summarized in Table 1. These data clearly show the high rate of growth in the study area as compared with the state. The average annual rate of growth for

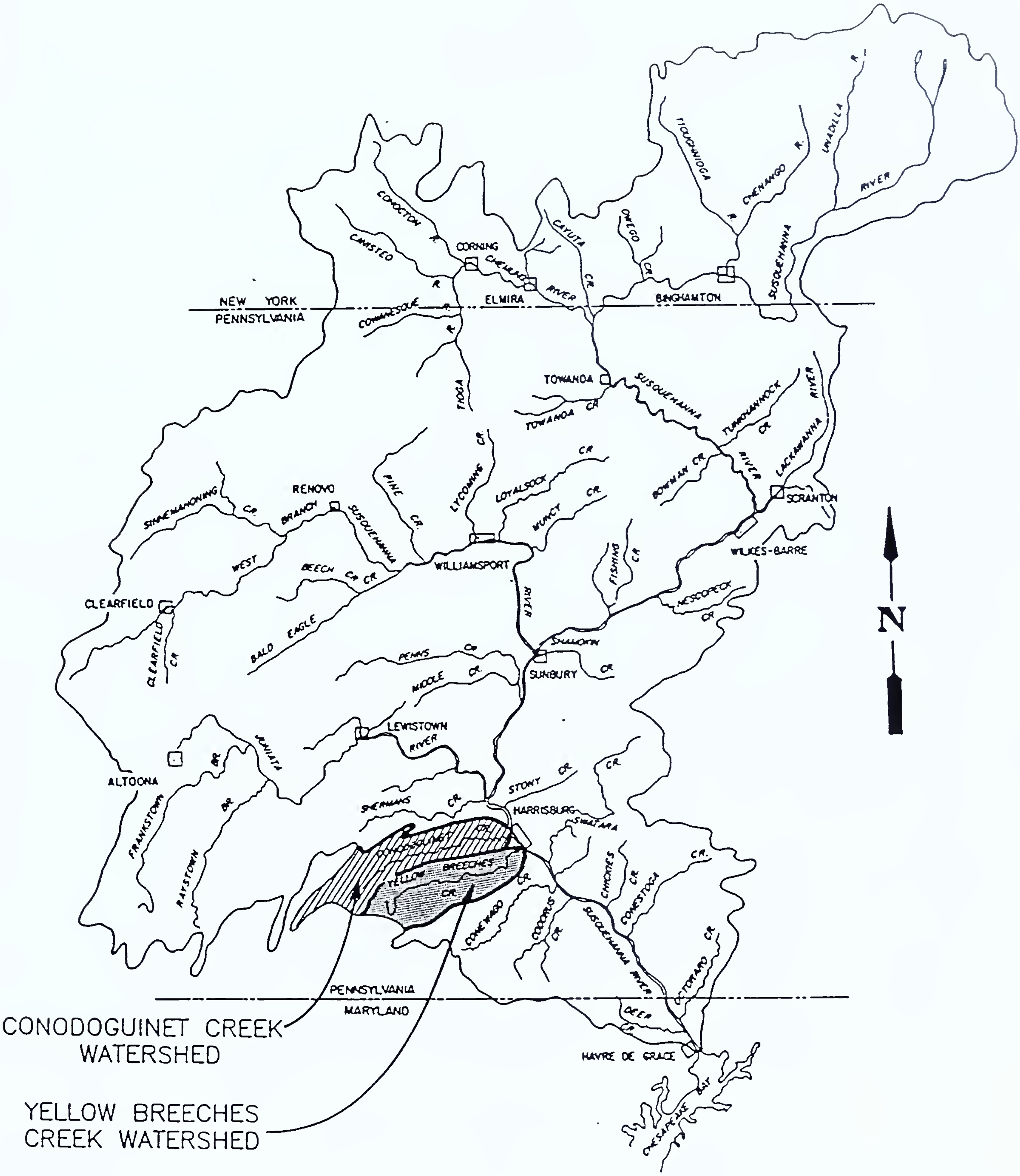

Figure 1. GENERAL LOCATION OF STUDY AREA

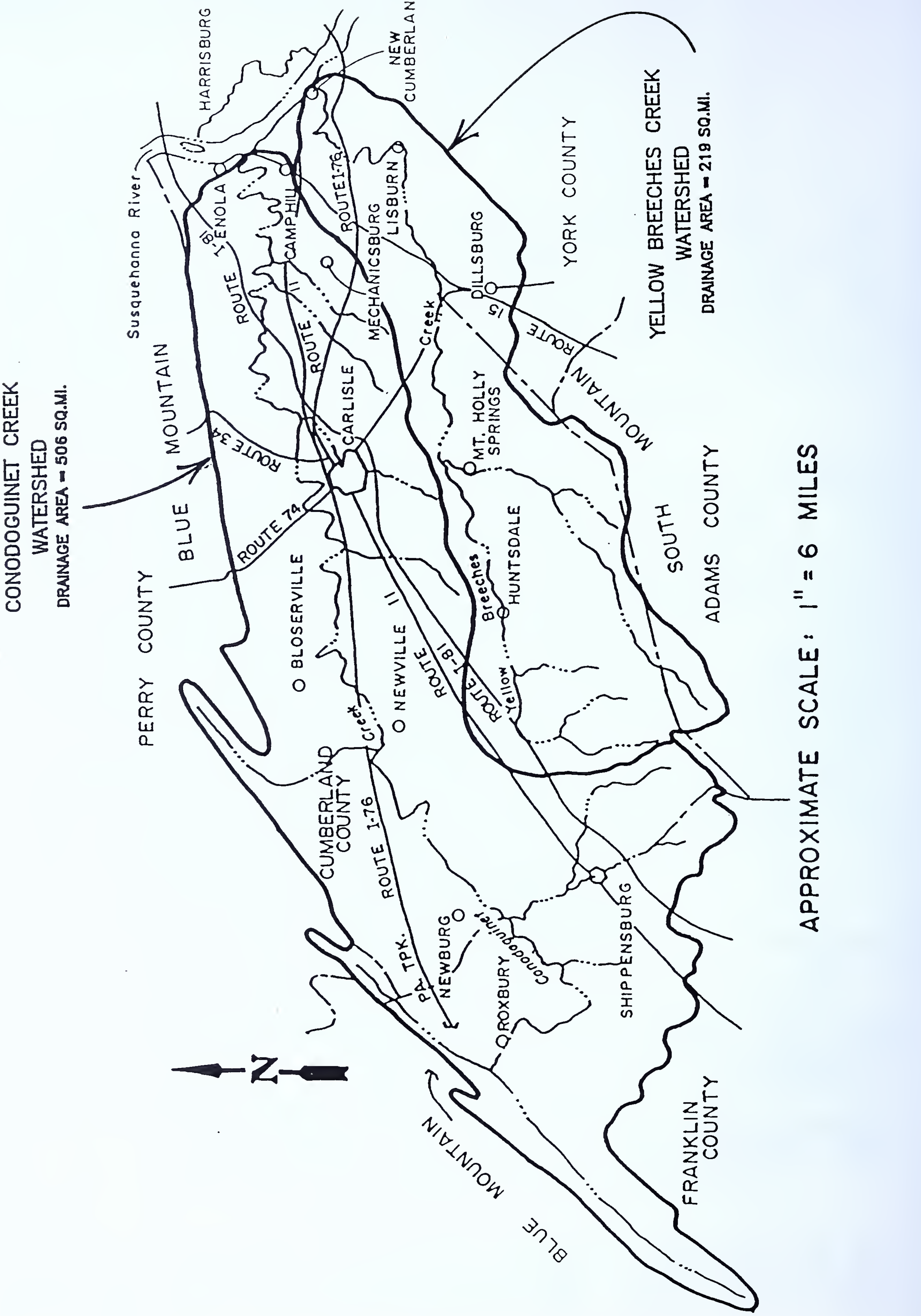

Figure 2. CONODOGUINET CREEK AND YELLOW BREECHES CREEK WATERSHEDS

COUNTY	COMMUNITY	1960	1970	1980	1990*	2000*	2010*
Cumberland	CAMP HILL BOROUGH	8,559	9,931	8,422	8,059	8,299	8,829
Cumberland	CARLISLE BOROUGH	16,623	18,079	18,314	17,752	18,047	19,201
Cumberland	COOKE TOWNSHIP	16	71	197	303	392	461
Cumberland	DICKINSON TOWNSHIP	2,025	2,416	3,037	3,428	3,687	3,806
Cumberland	EAST PENNSBORO TOWNSHIP	8,977	12,440	13,931	14,743	15,034	14,814
Cumberland	HAMPDEN TOWNSHIP	6,558	11,847	17,732	22,335	25,919	28,372
Cumberland	HOPEWELL TOWNSHIP	849	1,026	1,411	1,658	1,837	1,942
Cumberland	LEMOYNE BOROUGH	4,662	4,625	4,178	3,833	4,117	4,381
Cumberland	LOWER ALLEN TOWNSHIP	11,614	13,690	14,077	13,833	13,873	14,759
Cumberland	LOWER FRANKFORD TOWNSHIP	620	813	1261	1607	1878	2066
Cumberland	LOWER MIFFLIN TOWNSHIP	613	746	1,122	1,369	1,556	1,677
Cumberland	MECHANICSBURG BOROUGH	8,123	9,385	9,487	9,178	9,348	9,946
Cumberland	MIDDLESEX TOWNSHIP	2,333	2,857	4,506	5,617	6,474	7,056
Cumberland	MONROE TOWNSHIP	2,298	3,326	4,836	6,005	6,905	7,509
Cumberland	MOUNT HOLLY SPRINGS BOROUGH	1,840	2,009	2,068	2,035	2,038	2,167
Cumberland	NEWBURG BOROUGH	283	320	303	299	298	317
Cumberland	NEW CUMBERLAND BOROUGH	9,257	9,803	8,051	7,318	7,933	8,440
Cumberland	NEWVILLE BOROUGH	1,656	1,631	1,370	1,222	1,350	1,435
Cumberland	NORTH MIDDLETON TOWNSHIP	5,079	6,572	9,785	12,211	14,086	15,352
Cumberland	NORTH NEWTON TOWNSHIP	1,088	1,365	1,697	1,926	2,079	2,151
Cumberland	PENN TOWNSHIP	1,374	1,441	1,944	2,133	2,243	2,270
Cumberland	SHIPPENSBURG BOROUGH	5,071	5,172	4,376	3,959	4,312	4,588
Cumberland	SHIPPENSBURG TOWNSHIP	1,321	3,198	4,136	4,814	5,296	5,566
Cumberland	SHIREMANSTOWN BOROUGH	1,212	1,773	1,719	1,695	1,693	1,801
Cumberland	SILVER SPRING TOWNSHIP	4,044	6,324	7,148	7,594	7,780	7,697
Cumberland	SOUTHAMPTON TOWNSHIP	2,282	2,451	3,004	3,209	3,302	3,279
Cumberland	SOUTH MIDDLETON TOWNSHIP	5,424	7,521	8,941	9,854	10,404	10,571
Cumberland	SOUTH NEWTON TOWNSHIP	847	874	972	981	959	1,018
Cumberland	UPPER ALLEN TOWNSHIP	2,631	7,325	10,533	13,004	14,897	16,153
Cumberland	UPPER FRANKFORD TOWNSHIP	893	991	1,552	1,849	2,068	2,202
Cumberland	UPPER MIFFLIN TOWNSHIP	520	638	964	1,181	1,346	1,453
Cumberland	WEST FAIRVIEW BOROUGH	1,718	1,388	1,426	1,272	1,404	1,494
Cumberland	WEST PENNSBORO TOWNSHIP	2,612	2,937	4,329	5,067	5,597	5,902
Cumberland	WORMLEYSBURG BOROUGH	1,794	3,192	2,796	3,036	2,873	2,905
Franklin	LETTERKENNY TOWNSHIP	1,208	1,419	1,960	2,250	2,459	2,596
Franklin	LURGAN TOWNSHIP	1,406	1,649	1,986	2,160	2,263	2,305
Franklin	ORRSTOWN BOROUGH	318	262	247	214	225	233
Franklin	SHIPPENSBURG BOROUGH	1,067	1,364	885	785	810	840
Franklin	SOUTHAMPTON TOWNSHIP	2,678	3,292	4,604	5,417	6,026	6,452
York	CARROLL TOWNSHIP	1,558	2,386	3,097	3,653	4,012	4,191
York	DILLSBURG BOROUGH	1,322	1,441	1,733	1,870	1,919	1,892
York	FAIRVIEW TOWNSHIP	6,530	9,248	11,941	14,041	15,387	16,042
York	MONAGHAN TOWNSHIP	943	1,134	1,645	1,991	2,225	2,355
	TOTALS:	141,846	180,372	207,723	226,760	244,650	258,486
	PERCENTAGE CHANGE PER DECADE:		27.2%	15.2%	9.1%	7.9%	5.7%
AVERAGE ANNUAL PERCENTAGE CHANGE--1960-2010:		1.21%					
PENNSYLVANIA POPULATION (X 1,000):		11,320	11,801	11,865	12,019	12,101	12,206
	PERCENTAGE CHANGE PER DECADE:		4.3%	0.5%	1.3%	0.7%	0.9%
AVERAGE ANNUAL PERCENTAGE CHANGE--1960-2010:		0.15%					

* Source: PA DER Population Projections Report, Nov. 19, 1987

Table 1. POPULATION DATA FOR STUDY AREA AND STATE: 1960-2010

the period 1960-2010 is projected to be about 1.2 percent per year while the state's population increase will average 0.15 percent per year.

Certain parts of the study area have high levels of residential construction. These include, among others, Hampden, North Middleton, Upper Allen, and Fairview Townships. It seems likely that the U.S. Census Bureau's 1988 Current Population Survey and 1990 Census of Population will show growth rates in these townships exceeding those of the study area as a whole. Even so, population growth in the study area is expected to remain well above that of the Commonwealth.

3. Economy and Employment

Cumberland County's total surface area of 547 sq. mi. makes up approximately 75 percent of the entire study area. Also, in 1980, 86 percent of the study area's population resided in Cumberland County. Therefore, in the absence of data about employment in the various economic sectors at the municipality level, information about Cumberland County is used as a general indicator of the trends in the study area.

Table 2 contains Cumberland County employment information for the period 1980-87. During that period the economy, as measured by employment, grew over 25 percent, with the largest increases in the service sector. In the next decade, the high growth sectors of the economy are expected to continue their expansion at rates equivalent to those of the recent past. Beyond the year 2000, the rates of growth should gradually decline as the various sectors reach their saturation points relative to the needs of the population and the space available.

4. Land Use

Again, in the absence of data on land use for the individual municipalities throughout the study area, information about Cumberland County is used as a general indicator of the trends. Table 3 contains the latest land use information for Cumberland County. Unfortunately, because of different categorization techniques, there is not a comparable set of data from an earlier time period that could be used for comparison.

Table 2. CUMBERLAND COUNTY EMPLOYMENT DATA

SECTOR	NUMBER OF EMPLOYEES (Yearly Averages)			PERCENTAGE CHANGE
	1980	1985	1987	80-87
Manufacturing	16,139	16,371	16,173	0.2
Construction	3,206	3,402	4,122	28.6
Transport. & Public Util.	5,299	6,227	6,751	27.4
Wholesale & Retail Trade	20,540	25,094	27,818	35.4
Finance, Insurance and Real Estate	5,231	6,170	7,584	45.0
Services	12,286	16,784	18,457	50.2
State & Local Government	8,177	8,202	8,268	1.1
Totals:	70,878	82,250	89,173	25.8
Federal Government	N/C	9,030	8,922	
Totals:		91,280	98,095	

N/C = Employees not covered.

Source: Pa. Department of Labor and Industry, Office of Employment Security. Data are for nonagricultural workers covered by the Pennsylvania unemployment compensation system.

Table 3. LAND USE IN CUMBERLAND COUNTY

	1,000 ACRES	PERCENT
Cropland	133.4	38.1
Pasture	24.3	7.0
Forest	122.6	35.0
Urban & Suburban	42.8	12.2
Other	26.9	7.7
	350.0	100.0

Source: "Cumberland County, Pa., Table 2b, SCS Resources Inventory, 1982." SCS-USDA, Harrisburg, Pa., September 1986.

B. Water Resources Information

1. Hydrologic System

The concept of the hydrologic cycle, defined as the constant movement of water above, on, and below the Earth's surface, is central to the understanding of the occurrence of water and the development and management of water supplies. The principal features of the hydrologic cycle are shown in Figure 3 (Heath, 1987).

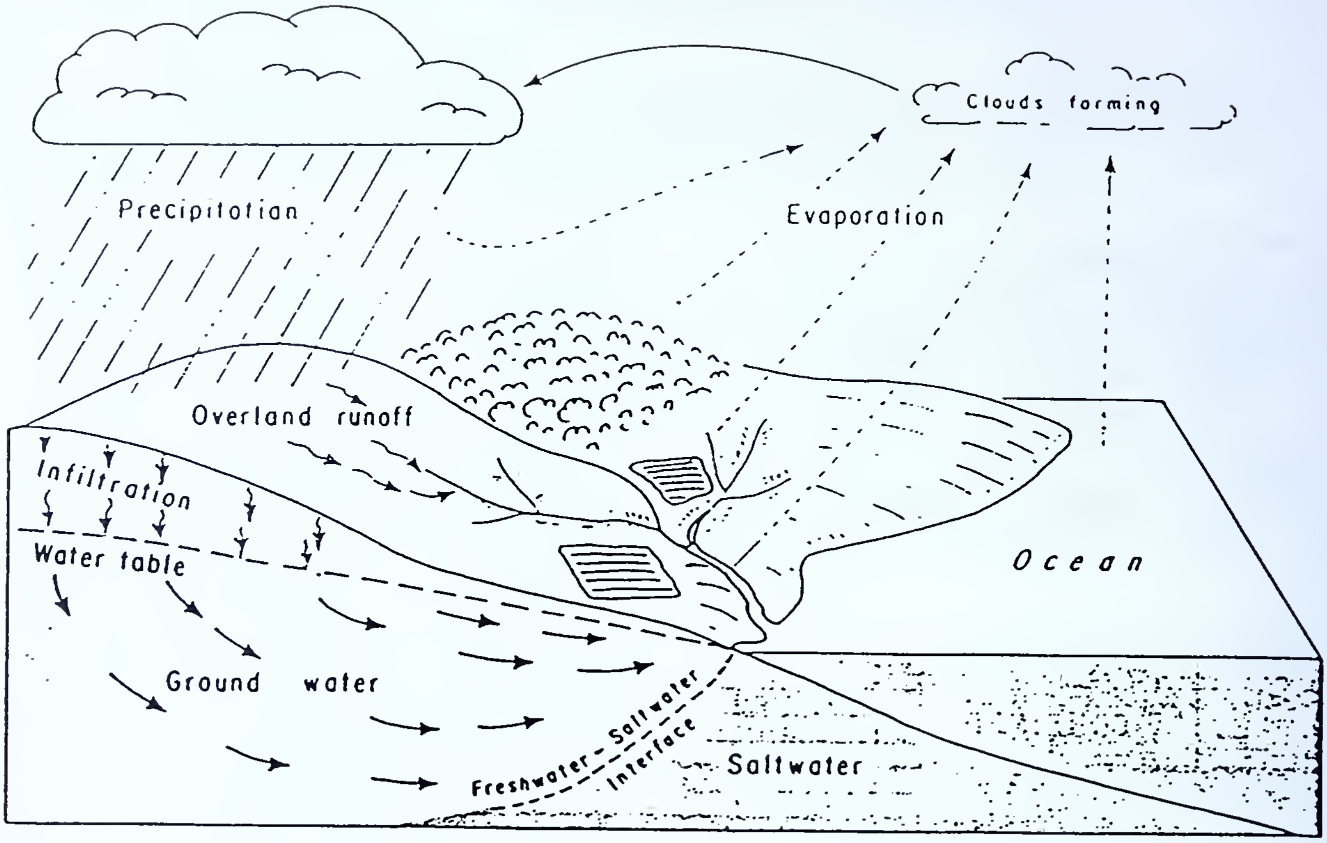

Figure 3. ELEMENTS OF THE HYDROLOGIC CYCLE

Evaporation from vegetation, from exposed moist surfaces, and from the oceans forms clouds which return the water to the land surface or water bodies in the form of precipitation. Precipitation that falls on the land surface begins to infiltrate into the ground. When and if the rate of precipitation exceeds the rate of infiltration, surface runoff or overland flow occurs. The first portion of precipitation that infiltrates into the soil replenishes soil moisture. Thereafter, the excess percolates downward to the water table and becomes ground water in storage. But ground water does not remain permanently in storage. It moves downward and laterally to sites of ground-water discharge such as springs on hillsides or seeps in the bottoms of streams and lakes or beneath the ocean. Water reaching streams, both by surface runoff and from ground-water discharge, flows in these streams and eventually moves to the oceans, where it is again evaporated to perpetuate the cycle.

Water enters the Conodoguinet Creek and Yellow Breeches Creek watersheds as precipitation. The study area receives, on average, 39 to 40 inches of precipitation per year. Precipitation is evenly distributed throughout the year, with no pronounced dry or wet seasons occurring on a regular basis. Occasionally, a tropical storm moving through the area produces heavy rainfall and, conversely, extended periods of little or no precipitation will occur.

Water leaves the study area as water vapor in the atmosphere or as overland runoff, or percolates underground, ultimately reaching the local streams and the Susquehanna River. Evapotranspiration consumes an estimated 55 and 48 percent of precipitation in the Conodoguinet and Yellow Breeches watersheds, respectively (Becher and Root, 1981). The remainder comprises the total streamflow of the Conodoguinet and Yellow Breeches Creeks. The local hydrologic system is composed of surface water and ground water, with both parts being dynamically related. The quantities of water that move through each part place natural limits on the overall development and management of the water resources.

2. Surface Water

Both the Conodoguinet and the Yellow Breeches flow eastward, parallel to the structural grain of the Cumberland Valley. The Conodoguinet Creek is classified as a warm water fishery. Although much of the stream is of fairly good quality, waters of its lower 16 miles are nutrient enriched (particularly phosphorous) and have reduced levels of dissolved oxygen (McMorran and Schott, 1988). The Yellow Breeches Creek has good water quality and is classified as a cold water fishery and a high quality stream in its upper reaches. Average annual streamflows are 19.8 inches for the Conodoguinet Creek and 21.0 inches for the Yellow Breeches Creek (Becher and Root, 1981). Runoff has distinct seasonal variation, with the period of highest runoff occurring in late winter or early spring, and the period of lowest runoff occurring in late summer and early fall.

Table 4 lists the average, minimum and maximum daily flows recorded at the two U.S. Geological Survey gaging station locations in the study area. Records have been collected by the U.S. Geological Survey on the Conodoguinet Creek near Hogestown from October 1911 through September 1917, from October 1929 through September 1958, and continuously since June of 1967. Similar records have been kept on the Yellow Breeches Creek at Camp Hill (Green Lanes Farm Bridge) from April 1909 through December 1919 and continuously since June of 1954. Maximum flows are the result of Tropical Storm Agnes in 1972 and Tropical Storm Eloise in 1975.

Table 4. HISTORIC FLOW PATTERNS
(flows shown in cfs)

Location	Flow Average	Minimum	Maximum
Conodoguinet Creek	595	26 (12/23/30)	33700 (6/23/72)
Yellow Breeches Creek	295	67 (9/13/66)	19300 (6/26/75)

During the majority of the year the flows in both streams are made up mainly from water discharging to streams from ground water. Direct surface runoff causes only moderate, short-lived rises in the streams. On average, ground-water discharge to the Conodoguinet Creek is about two-thirds the total streamflow. The ground-water discharge to the Yellow Breeches Creek averages 80 percent of total streamflow (Becher and Root, 1981).

3. Ground Water

The watersheds of the Conodoguinet Creek and Yellow Breeches Creek have abundant ground-water resources. Roughly 30 percent (13.3 inches) and 39 percent (16.8 inches) of precipitation reaches the ground-water system of the Conodoguinet and Yellow Breeches watersheds, respectively (Taylor and Werkheiser, 1984). This infiltrated precipitation eventually provides the baseflow to the streams. Numerous investigations of county or multi-county regions in the study area by both the Pennsylvania Topographic and Geologic Survey and the U.S. Geological Survey have provided very useful regional information on the availability of ground water, background water quality, depths to producing zones and potential yield.

Ground water in the study area is strongly influenced by the geology. Ground-water discharge to streams and large springs, the yielding characteristics of rocks, and directions of ground-water movement are largely dependent on the areal distribution of rock types and structure. Additionally, ground-water quality (and eventually surface-water quality) is affected by the interaction between ground water and the geologic materials with which it is in contact.

The aquifers in the Cumberland Valley are in a folded, faulted, and fractured sequence of carbonate rock and Martinsburg shale. The primary permeability of these rocks is quite low and ground water occurs in openings provided by joints, cleavage, and spaces between bedding planes. The limestones and dolomites are the most productive aquifers in the valley. However, individual carbonate formations vary widely in permeability. Some are relatively dense while others have appreciable permeable zones. Some limestones and dolomites are soluble and can dissolve along fractures and joints. Solution-enlarged openings can form a network of underground channels that contains large amounts of water in storage.

C. Water Use Characteristics

In 1986, approximately 220,000 residents relied upon the water resources of the Conodoguinet and Yellow Breeches watersheds for their source of water. Nearly 80 percent of them were served by 32 different water supply systems (including mobile home park systems). Several of these public water systems have service areas that extend slightly beyond the study area boundaries; however, since their sources are within the study area all of their customers served are included in the figures cited in this section. The remainder of the population in the study area used ground water supplies to meet their needs. Table 5 shows the latest estimates of water usage in these watersheds.

Table 5. ESTIMATED WATER WITHDRAWALS IN THE STUDY AREA

	DAILY				ANNUAL
	Total	Surface Water	Ground Water	Avg. No. Days per Yr.	Surface & Ground Water (Million Gallons per Year)
	(Million Gallons per Day)				
Self Supplied Manufacturing	4.02	0.97	3.05	258	1,209.68
Self Supplied Agriculture	6.35	5.68	0.67	17	65.58
Self Supplied Mineral Use	28.94	0.54	28.40	201	4,789.41
Self Supplied Institutional	1.89	1.10	0.79	365	688.90
Self Supplied Golf Courses	1.18	1.05	0.13	61	73.32
Public Water Supply (Including Mobile Home Parks)	21.79	17.32	4.47	365	7,955.11
Total					14,782.00

Source: Pa. DER Water Use Data System (most data are from the period 1983-87).

D. Previous Studies

Several major studies pertaining to the water resources in the study area have been done in the past. The Pennsylvania Department of Environmental Resources has produced the State Water Plan (PA DER, 1980), which is "a management tool to guide the conservation, development, and administration of the

Commonwealth's water and related land resources on a comprehensive and coordinated basis." The study area is addressed in this Plan as part of Subbasin 7, which encompasses the entire Lower Susquehanna River Basin. Also, the PA DER produced the Comprehensive Water Quality Management Plan (COWAMP) (PA DER, 1975), which was "to serve as a basis for formulating policy and taking action to abate pollution and protect and upgrade water quality" in the state's waterways. The Susquehanna River Basin Study Coordinating Committee also prepared a series of reports on all phases of basin characteristics.

NEED FOR THE STUDY

I. Existing Water Supply Problems & Projected Needs

Water shortages attributed to prolonged periods of lower than normal precipitation create occasional water supply problems in the study area. These problems are aggravated by the reliance on surface water streamflows as the primary source of water for many suppliers and the lack of surface water storage facilities that could be used to supplement water supplies when the natural streamflows are low. An aging public water supply infrastructure system exists in parts of the study area, severely limiting the efficiency and potential of some water supply systems. Additionally, several cases of ground-water pollution have been documented in the area. These instances of ground-water contamination range from the point source pollution occurring at the Letterkenny Army Depot and the Mechanicsburg Naval Ships Parts Control Center to large areas of high nitrate contamination caused, most probably, by a combination of farming practices and malfunctioning on-lot sewage disposal systems.

The population data presented in Table 1 shows that the study area, between 1980 and 1990, is expected to grow at a rate 7 times faster than the state average. As the area continues to grow, the demand for water will also increase. Water supply projections made several years ago and considered adequate for several decades have already been reached. Currently, there are four water supply providers making application to the Pennsylvania Department of Environmental Resources for increases in their taking of surface water from the watersheds. These increased demands will likely cause an increasing number of periods in which the watershed resources will not be able to meet all the demands placed on them.

II. Goals and Objectives

The primary objective of this study is to identify all of the water supply needs that are currently in place in the two watersheds, project future water supply needs, and assess the ability of the watersheds to meet the current and future demands. The assessment will identify and locate any deficiencies, based on either current or projected usage levels. Water management guidelines will be developed that address the deficiencies and evaluate alternatives to provide adequate water supply for the study area in the future. In addition, the procedures developed during this study will aid the Commission in assessing the water resource needs, uses and problems in other areas of the Susquehanna River Basin.

ORGANIZATION & MANAGEMENT

I. Administration & Coordination of Study Program

An SRBC staff person has been designated as Study Manager, who, with the assistance of an interdisciplinary team of SRBC staff members, will develop a plan of study and establish and maintain liaison with a Study Committee as well as other public and private interests. The Study Manager will monitor adherence to the plan of study as the work progresses, prepare scheduled reports, guide the preparation of the final study report and provide overall management to achieve the stated purposes of the study within a predetermined schedule and budget.

The SRBC promotes and participates in a number of interagency activities designed to enhance coordination and cooperation with other water resource agencies and private interests. In order to insure coordination and cooperation during this study, the Commission staff will actively coordinate their actions with and keep informed the appropriate Federal, State, and local agencies.

II. Public Involvement

A. Study Committee

Under authority granted in Article 3, Section 3.11, of the SRBC Compact, the SRBC will establish a Study Committee as an active part of the Conodoguinet-Yellow Breeches Watershed Study program.

1. Role and Purpose

The Study Committee (Committee) is the vehicle by which the general public and other interests are linked to the ongoing activities of the SRBC study. The Committee will play a vital role in the review and development of the Plan of Study by providing local input (data, observations and opinions), reviewing study progress as to technical validity and conformance with the Plan of Study, and providing comments on the findings and recommendations of the draft final report. The Committee will also serve to disseminate study information and to inform the general public of study progress. Although not cast as a policy making body, the Committee will be of valuable assistance in the development of a strategy for managing the available water resources to meet current and future water supply needs in this rapidly developing area of the Lower Susquehanna River Basin.

2. Composition

The Committee will be comprised of representatives of organizations and agencies as well as individuals with a demonstrated interest in the management of the water resources in the two watersheds. Members will represent different disciplines while overall makeup of the Committee will include interested citizens and representatives from local government, water-resource agencies, industry, and agriculture. An effort will be made to effect a balance in the respective representation of these interest groups. Further, some technically oriented members will be invited to act as 'on call' advisors. The Study Committee is expected to be a body of 15 to 18 members.

3. Method of Operation

An initial meeting will be held to acquaint the Committee members with SRBC staff and to introduce the proposed Plan of Study. Following the initial meeting and as study progress warrants, the Committee will meet to:

a. Receive study progress reports;
b. Review study data and comment thereon; and,
c. Review and discuss any problems or concerns arising as a result of study findings.

The Committee may elect its own chairperson or spokesperson, who will have the responsibility to assure continuous and effective communication of study matters with SRBC staff and the Study Manager. The Committee may also appoint subcommittees to work on various aspects of the project.

With mutual consent of the SRBC Study Manager and the Committee chairperson, meetings may be scheduled at any time agreed upon for purposes of discussion pertinent to study progress. Committee meetings may be held at various locations within the study area with meetings expected to be called approximately every 3-4 months over the term of the study program.

The SRBC Study Manager and other Commission staff will make every effort to work closely with the Committee. Comments and suggestions are encouraged at any time and will be given full consideration in developing the final study report.

SCOPE OF WORK

The proposed scope of work to be carried out in order to meet the goals and objectives of this study is:

I. Evaluation of Present Water Usage & Determination of Future Needs

   A. Public Water Systems

      1. Determine withdrawal locations, historic quantities of withdrawals, withdrawal capacities, treatment capacities, and permitted limits of all withdrawals.

         a. DER files
         b. SRBC permit files
         c. Other agencies (PA Public Utility Commission, PA Department of Health, etc.)
         d. Contact companies directly to discuss

            1) information verification
            2) exact definition of service area and plans for expansion of service area
            3) plans for increasing water supply availability to meet future demands
            4) existing & potential water quality concerns
            5) leak detection programs
            6) efforts to reduce unaccounted-for water
            7) extent of water conservation efforts

      2. Make estimates of future water needs through year 2010.

         a. Establish locations & levels of potential growth

            1) zoning analyses (both present & anticipated)
            2) analyze development plans already filed to determine types and numbers of residential and industrial units

         b. Develop a range of future water needs

            1) use individual public water system records to make projections
            2) use water industry design criteria to make projections
            3) modify projections assuming reductions caused by water conservation
            4) use other methods as available data allows

B. Self-Supplied Water Uses

1. Industrial

   Locate users and their withdrawal locations, collect data on historic quantities of withdrawals, present usage, maximum withdrawal capacities, treatment capacities (if any), permitted withdrawal limits, physical data on wells if appropriate, & estimate future water quantity/water quality needs.

   a. DER database
   b. SRBC permit files
   c. Regional agencies
      1) Capital Region Economic Development Corporation
      2) Chambers of Commerce
      3) Council of Governments
   d. Direct contact with industries

2. Domestic

   a. Estimate both present usage & future needs
   b. Collect data on present water quality concerns

3. Agricultural

   Locate users and their withdrawal locations, collect data on historic quantities of withdrawals, present usage, maximum withdrawal capacities, treatment capacities (if any), permitted withdrawal limits, physical data on wells if appropriate, & estimate future water quantity/water quality needs.

   a. SRBC permit files
   b. County Extension offices
   c. Pa. Dept. of Agriculture
   d. Pa. Fish Commission
   e. Irrigation equipment suppliers

4. Other Uses

   Determine locations, magnitudes, and purposes of any other uses.

C. Instream Flow Needs

Evaluate needs for aquatic habitat, wetlands, wildlife, and recreation.

1. Fish & Wildlife Service
2. Pa. Fish Commission
3. Pa. Game Commission
4. Academic contacts
5. Watershed associations

D. Identify Presence Of or Need For Out-of-Basin Diversions and Watershed Transfers

E. Summary of Water Quantity Needs

II. Analysis of Water Availability

A. Evaluate Water Quantity Availability

1. Surface Water

    a. Examine gage records & compute flow statistics
    b. Identify critical low flow periods
    c. Use drainage area ratios to transfer gage analyses to selected locations of interest
    d. Establish flow criteria limiting surface water withdrawals

2. Ground Water

    a. Prepare water budgets for both watersheds
    b. Evaluate ground-water flow characteristics
    c. Estimate aquifer yields and the resulting impacts on other water budget components
    d. Identify existing or projected areas where ground-water availability may be limited because either development is intense or the resource is limited

B. Evaluate Water Quality

1. Surface Water

    a. Locate all permitted discharges, historic quantities of those discharges, maximum discharge permit limits, types of water treatment, and treatment capacities

        1) DER files
        2) NPDES permits
        3) other agencies
        4) direct contact with companies

    b. Correlate existing stream quality with established water quality standards
    c. Identify existing and potential future problem stream reaches

2. Ground Water

    a. Gather historic ground-water quality analyses for select sampling locations

        1) USGS databases
        2) EPA databases
        3) DER databases
        4) SRBC files
        5) Other data sources

    b. Supplement historic data with samples taken at selected locations
    c. Locate permitted facilities that may impact water quality (underground injection sites, landfills, storage tanks, etc.)
    d. Characterize water quality by lithology & current land use
    e. Identify existing water quality problem areas
    f. Identify potential future problem areas

III. Identify Water Supply Problem Areas

A. Identify Existing Problem Areas

Analyze the information concerning current water quantity usage and water quality. Determine whether water supply sources can sustain all current demands.

B. Identify Future Problem Areas

Analyze the information concerning the investigation of future water quantity needs and water quality. Determine whether water supply sources can sustain all estimated future demands.

IV. Investigate Water Resource Management Options

A. Reduce Demand

1. Limit development (residential, commercial, and industrial)

2. Institute water conservation practices

    a. Demand management
    b. Supply management

B. Review Public Water System Operating Practices

C. Increase Water Supplies

1. Increase levels of water treatment to meet applicable standards

    a. Evaluate technical feasibility
    b. Evaluate economic feasibility

2. Increase ground-water withdrawals

3. Increase surface-water withdrawals

4. Investigate surface-water storage potential

    a. Evaluate site feasibility
    b. Evaluate financial feasibility
    c. Evaluate environmental feasibility

5. Identify potential artificial ground-water recharge areas

6. Evaluate the potential for interbasin transfers

V. Conclusions & Recommendations

STUDY SCHEDULE

The entire study process, beginning with the adoption of a final plan of study and continuing through the appropriate investigations, and preparation and publication of a final report, is scheduled to be accomplished within a twenty-four month period. It is expected that the actual technical work of data gathering and analysis of options will take fifteen to eighteen months, but a substantial amount of time will be needed for report preparation and review. A graphic display of the tentative study schedule is shown in Figure 4. The numbered work tasks identified under the major headings correspond to the work items detailed in the scope of work.

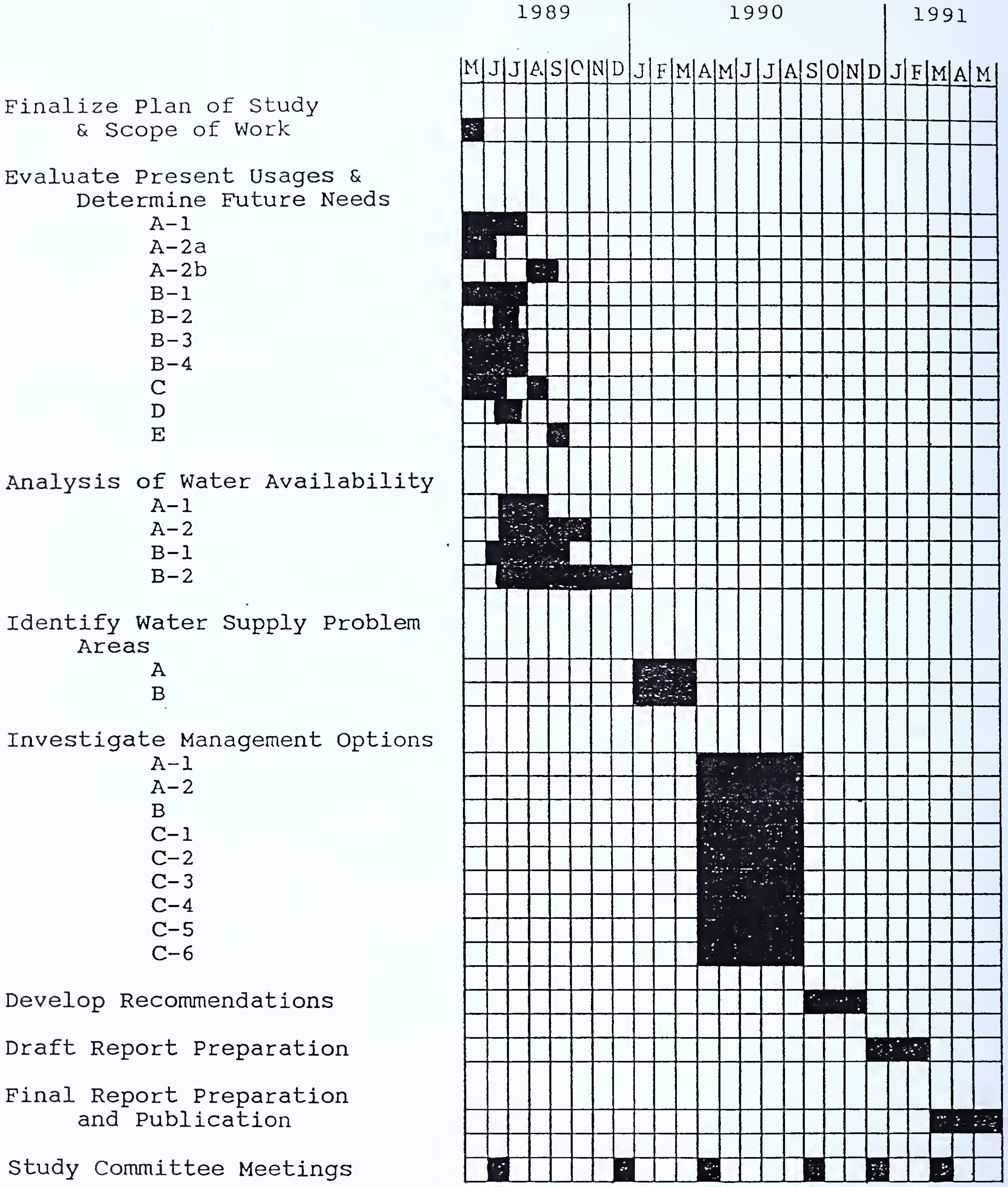

Figure 4. STUDY SCHEDULE

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